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PRAXITELE:
A coherent programme of self-service electric cars that will help to solve many urban transportation problems

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ABSTRACT: In this article we describe the self-service electric car programme PRAXITELE. This experimental service is now in the course of being set up in Saint Quentin en Yvelines, a suburb about 15 km from Paris. It is based on the use of small compact electric cars that are made available to the public through a self-service rent a car system. The cars are parked in conveniently located parking stations, and are ready to be used for short trips. They may be returned to any one of these. This system therefore meets the same need as the private car, without the inconvenience. The urban traveller uses the efficient high volume public transport system to travel in and out of town or for inter-urban trips without sacrificing the convenience of the private vehicle. It is thus possible to optimise urban parking and reduce pollution.

Much effort has been spent to simplify the use of the system in order to make it as attractive as possible and to let it become a "natural" reflex. Access to the car is obtained with a remote reading travel token that will also be used for the Parisian public transport system. Charging is done automatically and is totally transparent to the user.

1. INTRODUCTION

Today's cities are overwhelmed with problems caused by immoderate use of private cars. The electric vehicle will certainly help to reduce pollution and congestion, but lack of parking space will continue to prevail. Public transport is naturally the ideal solution but this mode of transport is actually losing popularity as commuters tend to prefer the comfort of their private car in spite of traffic jams. There are many causes for this loss of popularity, that we do not intend to analyse here but it is obvious that we must strive to create transportation services that really cater for the needs of each client if we are to succeed in reducing the use of the private vehicle. The major problem seems to stem from the inability of public transport systems to provide door to door service. They are, however, much more efficient and it therefore seems important to develop intermediary a complementary system wich will take advantage of this higher efficiency for longer trips while providing the door-to-door convenience of the car.

The self-service programme now starting in France proposes just such an alternative, that will provide the same convenience as the private car without its drawbacks. One car is used many times a day, thus requiring a single parking place for many trips. The cars will be available at convenient places in the city centre thereby allowing the traveller to use public mass transport to ride into the cities while enjoying the freedom of the individual car for his day to day business. These cars will permit a significant reduction of traffic in the cities, not only because parking space is optimised but also because mass transit capacity is better used.

In this paper we fully describe the mechanisms used and the organisation. The system is based on the use of remote reading payment cards, automatic charging stations, a centralised control center and an automatic locating and traffic guidance system. We will present the essential information obtained by extensive surveys that were conducted during the planning stage of this programme. It is now possible to have a clear idea of the real economic viability of the scheme and to estimate the impact that it will have on urban traffic.

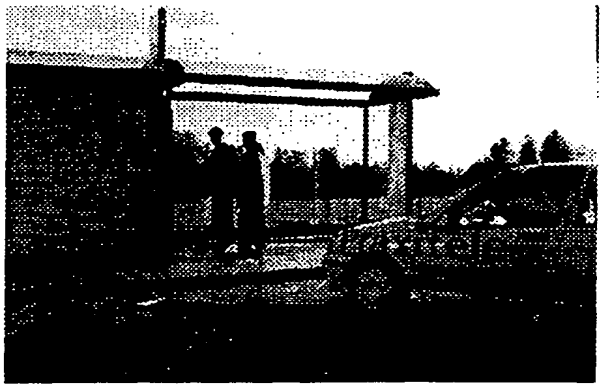

Figure 1 Self service programme starting at Saint Quentin en Yvelines near Paris.

2. DESCRIPTION OF THE PRAXITELE SERVICE

• The PRAXITELE service is based on a fleet of small compact cars that are readily available in PRAXIPARC stations distributed in the area served. These stations will be distributed in such a way that the maximum walking distance to the nearest pick-up point is less than 300 meters. This implies that we have approximately the same density as the metro stations in Paris, and about 300 stations and some 10,000 cars would be required to cover the city of Paris. Figure 1 shows the prototype station.

• The PRAXICARS are available at any moment to any registered client who has his or her remote reading travel token.

• Each PRAXICAR has a luminous signal that indicates whether it is ready to be used. It is therefore possible to direct the clients to those cars that are ready and charged.

• The client chooses his car and presents his remote reading travel token close to the detecting antenna located near the driver's door (figure 2). The client code is compared with a centralised data base, verified, and the doors are unlocked. It is now possible to start the car by inserting the card into the dashboard (figure 3) and the driver is free to take the car wherever he wants provided he stays in the city limits.

• It is always possible to leave the car for short periods without returning to the PRAXIPARK, but this unused driving time must be paid for, thus encouraging all clients to free their vehicles as quickly as possible in order to maximise their use.

• Continuous contact is maintained between the car and the main base. The client can thus ask for help or advice at all times and maximum security is obtained.

• At the end of the trip, the client takes his car to the nearest PRAXIPARC and leaves it on the reserved parking area. On leaving the car he passes his remote reading travel token close to the car antenna, the car is automatically closed and the sum due is deducted from his account.

• It must be stressed that the remote reading travel token would be identical to that used in the future for Parisian urban transports - only the fee would change. PRAXITELE is therefore part of a global transport system in which we attempt to provide (almost) door-to-door transportation.

• Electric cars are used, not just because they are non-polluting but also because they provide considerable other advantages. Maintenance will be low. Charging is fully automatic and totally transparent to the user. There will be no fuelling to be taken care of. The limited range is almost an advantage as the cars are intended to be used in a restricted area. There will be no risk of them being driven to another city. The specific charging system will further help to maintain the integrity of the fleet.

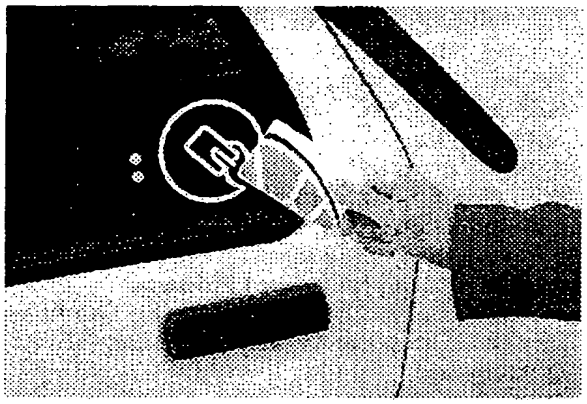

Figure 2 The client presents his travel card to open the car doors

Figure 3 The client inserts his travel card into the dashboard

3. GOOD ELECTRIC CARS ARE AVAILABLE, BETTER CARS WILL COME

The electric cars now coming on the market are perfectly adapted to urban driving in spite of their somewhat limited range, as the average distances travelled are very short. However they obviously cannot totally replace the IC family car. Indeed, few are those that are willing to buy a car that cannot serve on all occasions. It is therefore unrealistic to expect a major switch to electric cars in the near future and urban pollution will not be significantly influenced by this new mode of transport unless we also rethink the way the cars are to be used.

As indicated previously, the self-service car concept fully exploits the advantages of the electric cars without being restricted by their limited range. Maintenance is limited and refuelling unnecessary. A first study has shown that total distances travelled by hire cars during a day will be relatively small. They remain compatible with the range of present day vehicles. Charging can be done during the waiting periods, thus extending the range even further. The present project is based on the compact RENAULT CLIO, which is typical of modern European small cars and is well suited to urban traffic. Very small dedicated cars, are now being developed for use in the near future. They will be even better adapted to individual transport. It would be particularly advantageous to use very short cars capable of being parked at right angles in the space normally reserved for parallel parking. Two to three cars could thus occupy the space reserved for an ordinary car.

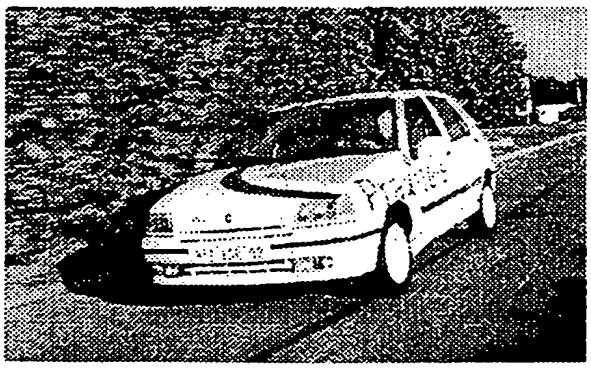

Figure 4 The PRAXICAR is a convenient modern compact

4. MODERN INFORMATION TECHNIQUES ARE ESSENTIAL TO THE SUCCESS OF THE PROJECT

It is obvious that the PRAXITEL project could not be realised without resorting to the latest technology. The remote reading travel token is one example, as is the immediate communication with the home base through radio frequency data channels. The position of the car can be determined at any moment by the installed GPS system. Theft and vandalism will be enormously reduced and safety of drivers ensured. This will permit us to avoid the major pitfall of previous self-service car programmes. Finally, as mentioned earlier, the automatic charging replaces messy fueling and reduces maintenance.

5. CLIENTS AND MARKET POTENTIAL

Our market study has shown that PRAXITELE corresponds to a real need, offering a service that is complementary to public transport and taxis.

5.1. Three to five percent of all urban trips. The PRAXITELE concept has been well received by all people questioned. Between 7 and 11% of drivers in the city have indicated their intention to use the service for about 50% of their urban trips. This allows us to estimate a 3 to 5% modal transfer from the private car.

5.2. A clearly identified client base. PRAXITELE is designed to limit the excessive use of personal vehicles in city centres for short distances and where parking has become a major problem. It also functions as a useful complement to heavy transport systems in situations where such services are uneconomic. We can therefore clearly identify the potential clients:

- **City business**: This concerns principally the active business man or woman, 35 to 65 years old, active and highly mobile who directly benefit from the following advantages: less time lost due to the increased availability of vehicles and the ease of parking, an alternative to the use of their private vehicle.
- **Private use**: This concerns clients without professional activity who are principally attracted by the ease of parking.
- **Local use during short trips**: This use is essentially professional and concerns the business man or woman on short trips who often comes to the same town and requires local transport on a regular basis.
- **Tourism**: This segment concerns men and women over 30 years of age, pensioners and business men or women who are attracted by the possibility of a private electronic guided tour.

5.3. Niche markets Further studies have been undertaken to explore other market possibilities. This work has not as yet been finished but three specific niche markets have been identified:

- Organised visits in towns, industrial centres or major events.
- Small industrial or commercial user groups. This aspect is one of the most promising as the initial client base is small and well defined,

thus limiting initial investment. The group can be gradually opened to the general public.

- Replacement for existing public transport systems. This is not strictly a niche market as it closely corresponds to the real vocation of PRAXITELE. The car service is available at all times, thus permitting the direct replacement of night or weekend public transport. The installed PRAXITELE car fleet can equally serve as a complement to existing tourist structures.

6. FEES

PRAXITELE is designed to offer an alternative to potential clients who already possess a car and a drivers licence. The fixing of future fees has therefore required an extensive socio-economic study in order to establish a competitive balance with other means of transport.

The fees have two major objectives. Firstly they must cover a major part of the total costs. In many cases installation of a service like PRAXITELE permits a better regulation of urban transport and as such will be partially funded by local authorities, but the global cost must be at least comparable with other installations. Secondly, they influence the use that is made of the service, thus ensuring the complementarity of each mode of transport.

6.1. The following choices have been made

• The cost to the user will be lower than a taxi for short trips, but more expensive than taxis for long distances. It will always be more expensive than mass transit. This permits the system to be inserted peacefully into existing infrastructures. Long trips are generally preferred by taxis who obtain a major part of their revenue from this kind of service. On the other hand they present a disadvantage for PRAXITELE as they tend to induce a poor distribution of the fleet. An increase in interest in public transport and selfservice cars and a move away from private cars would actually be beneficial to taxis who would thus also benefit from an increased client base.

• Time of usage will be an important factor for the fares. Shopping stops will be paid for. This will induce clients to return their cars as quickly as possible, thus increasing the potential use of what will always be a limited fleet.

• Regular reduced fares for specific times and specific trips will permit the regulation of the spatial distribution of the fleet.

6.2. Fees Structure The basic service offered is defined by the possibility of using a car and the guarantee of a parking spot on arrival. Certain other supplementary services can be allowed for and will be integrated into the fees as these become available. These include reserving the car, leaving the car outside of a parking station, use of a car phone and extra information services that will later be integrated (guided tours, hotel reservation, train reservation, etc.). The client will be billed monthly on the following basis:

- membership fee
- cost of each trip
- additional services used

Occasional users of the system will be billed using the same fee structure. As indicated previously, the trip cost is modulated to optimise the distribution of vehicles. We are testing the following rates for the Saint Quentin programme:

Subscription	1 day	20 francs
	10 days	120 francs
	1 year	1,000 francs
Use		
First 5 minutes		8 francs
every following minute		3 francs

(1 franc ~ US$ 0.2)

This structure favours PRAXITELE for short trips (typically less than 14 minutes or less than 8 kilometres), but the cost increases sharply after 5 minutes and taxis are therefore cheaper for longer trips.

7. LEGAL ASPECTS

Extensive preparation has gone into the legal aspects of the system in order to avoid future difficulties that may hinder the project. It has been clearly established that PRAXITELE can be considered as a public service that is accessible to all of the public. The system can therefore be operated under the same conditions as other public transport systems.

The exact nature of the commercial contract that will bind the transport company and the client still has to be clearly defined as the service rendered lies between that of traditionnal public transport facilities and the conventional hire car. It seems, however, that there will be no major problem in terms of insurance and public responsibility. The driver is identified by his transport card and personal number so that it is possible to know if he has a drivers licence. He is obliged to furnish his personal identification number every time he uses the service. Any lost, stolen or otherwise invalid card is immediately detected.

8. ECONOMIC VIABILITY

It has been necessary to establish a complete socio-economic study of the proposed service in order to evaluate its potential economic viability. The technical feasibility of the programme was first tested using statistical simulation to determine the movements of the vehicles and the clients. This work was first initiated by a number of surveys

conducted in Paris and the suburbs to establish a traffic profile. We now have a reasonably good idea of the number of cars, the ratio of the available parking places that will be necessary and distribution of the cars. As indicated earlier, it was also shown that PRAXITELE will be able to replace between 3 and 5% of all mechanised transport in urban areas. The total impact of the service was thus evaluated.

8.1. Parking surface The rotation factor of a parking space (number of cars that use a given space per day) is about equal to the highest obtained for meter parking. By optimising parking space it is possible to obtain a total gain in parking surface used for a given number of trips, of 60 to 70% .

8.2. Comparison using the space-time criteria A comparison has been made with other transportation modes based on a space-time criteria (that is, the road surface used by the time necessary to travel 5 kilometres). It was shown that PRAXITELE has a value of 17 to 22 m^2*h compared to a value of 30 to 90 m^2*h for the private vehicle. This is however very much lower than that attained by heavy public transport vehicles (4 to 7 m^2*h).

8.3. Total cost of the system This study was based on figures obtained in 1993 using three different scenarios:

a- Paris, using a fleet of 8,000 cars to serve all of the 20 arondissements and some of the nearby suburbs

b- A large urban suburb using a fleet of 800 cars

c- A city of 300,000 inhabitants, using 300 cars.

Each car will be used between 5 and 6 times per day. The rates were fixed at between 20 to 50 francs (US$ 4 - US$ 10) for a 3 to 6 km trip. The total distance travelled for the three scenarios is as follows:

a- 100 million km (that is 12,500 km/vehicle/year)
b- 10 million km (12,500 km/vehicle/year)
c- 2.1 million km (7,200 km/vehicle/year)

We have obtained the following figures, summarized in table 1:

- Total investment par car of 140,000 francs. This includes all infrastructure but does not include batteries which are leased.
- 60% of this concerns the car and its equipment, 10 to 15% is used for the stations and the remaining part covers investment needed for the structure.
- Operating costs run from 4 to 6 francs per kilometre, that is, between 21 and 23 francs per trip.
- Revenue should fall between 27 and 32 francs per trip.

Under these conditions, it is estimated that operating costs will be readily covered. But total payback covering the operating costs and the capital investment can only be attained for very large fleets. The exact figures are very much dependent on the total number of trips per day. These will only be available at the end of the Saint Quentin Experiment.

Table 1 Results of the simulation

	City of Paris	Large urban suburb	city of 300,000
number of vehicles	8000	800	300
average number of cars per station	40	20	15
number of trips per year	18,000,000	1,800,000	600,000
average distance **	5.5 km	5.5 km	3.5 km
cost to the client	20 to 50 francs		20 to 40 francs
investment / vehicle *	135,000 francs	130,000 francs	140,000 francs
Global economic balance			
(revenue - operating cost) **	+ 9 francs	+ 11 francs	+ 5 francs
(revenue - operating cost - investment) **	- 2 francs	~ 0 francs	- 8 francs

* (without batteries)
** per trip
(1 franc ~ US$ 0.2)

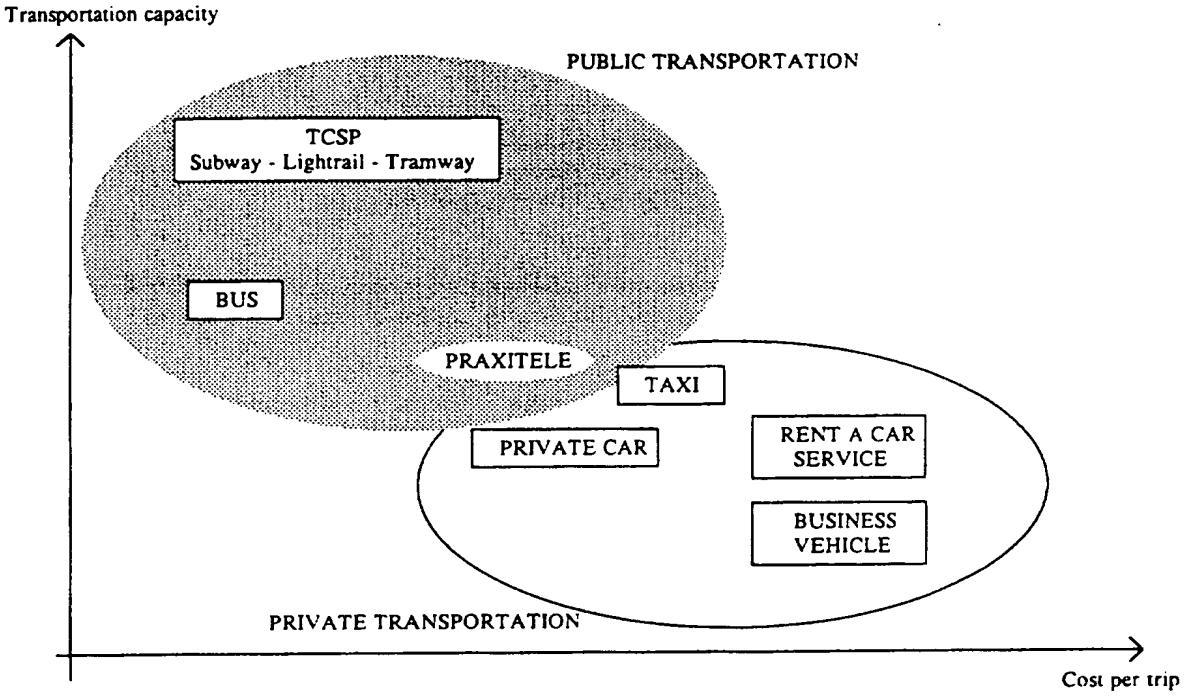

Figure 5 Comparison of PRAXITELE with other available transportation means

9. CONCLUSION

The PRAXITELE programme is part of a global urban transport programme. It will help to reduce congestion and pollution in urban areas by providing an electric car service that is complementary with existing public transport systems.